FERMIAC or Fermi's Trolley

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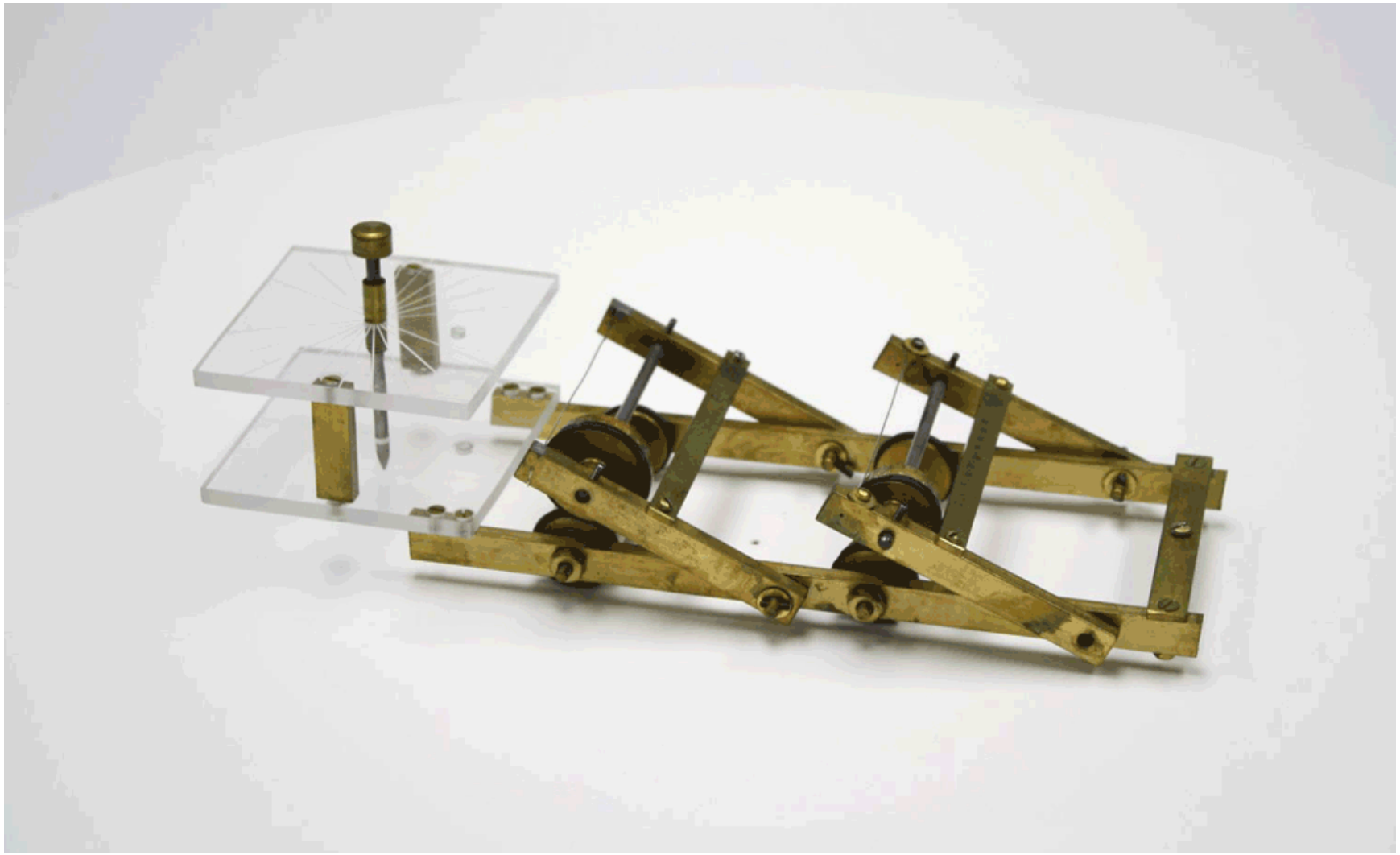
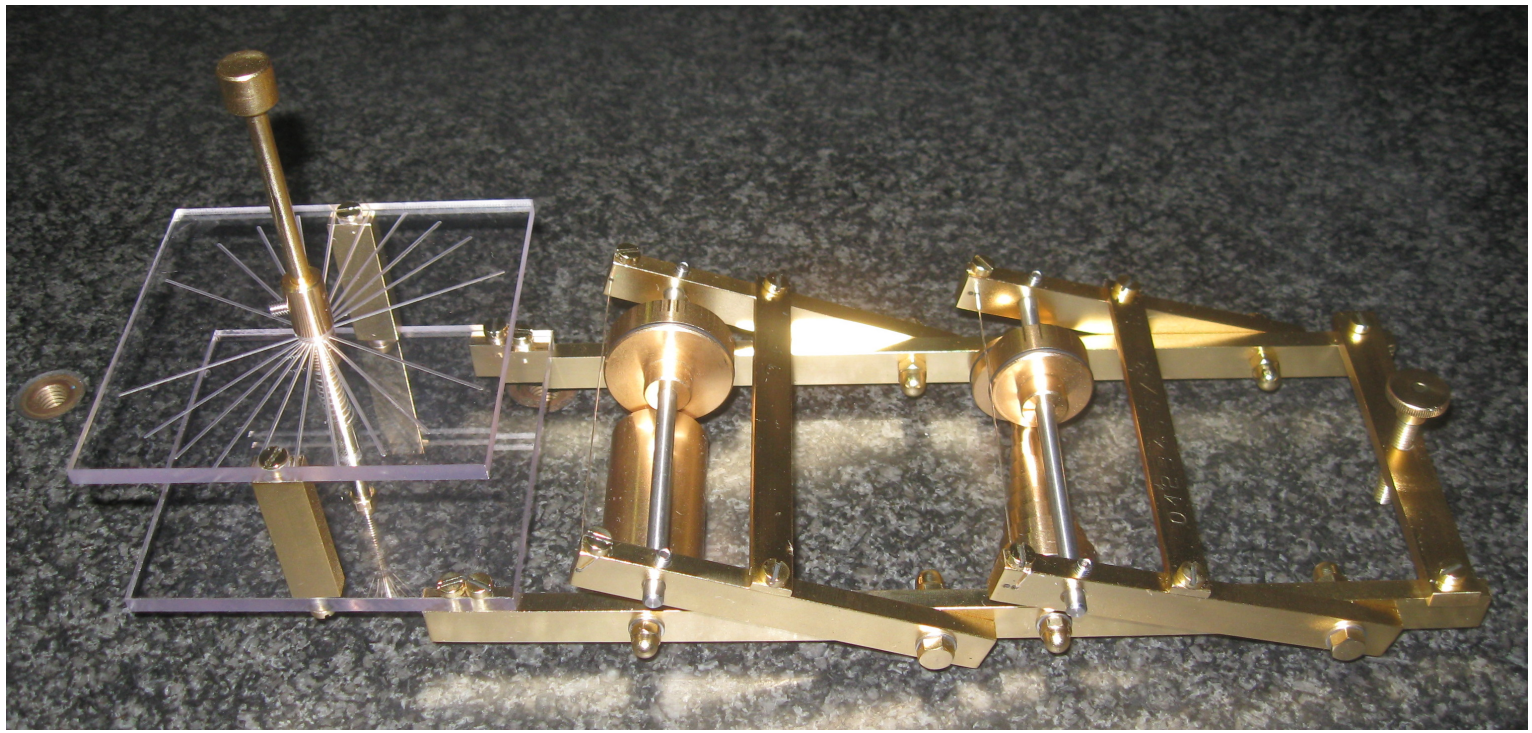
The FERMIAC



The Fermiac on display in the Bradbury Science Museum in Los Alamos.

The FERMIAC



Exact replica of the Fermiac built at the Officine INFN of Bologna.

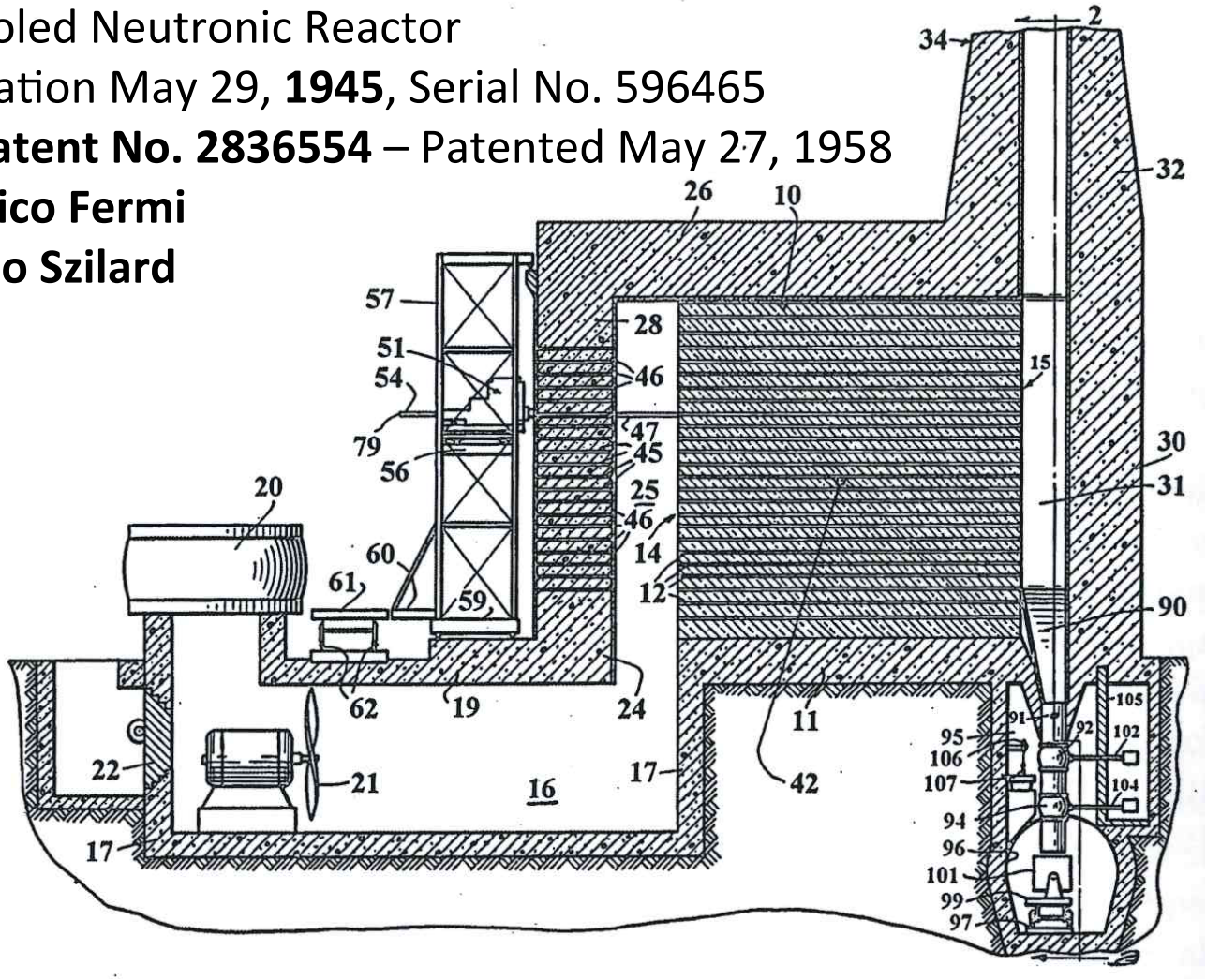
The FERMIAC

- The FERMIAC (Monte Carlo trolley, Fermi's trolley) was invented by Enrico Fermi and constructed by Percy King at Los Alamos in 1947.
- It is an analog computer used to determine the change in neutrons population with time in a nuclear device (via the Monte Carlo Method).
- Conceived while ENIAC was unavailable, used for two years by the Bengt Carlson's T division group.

The FERMIAC and the study of an Air Cooled Neutronic Reactor

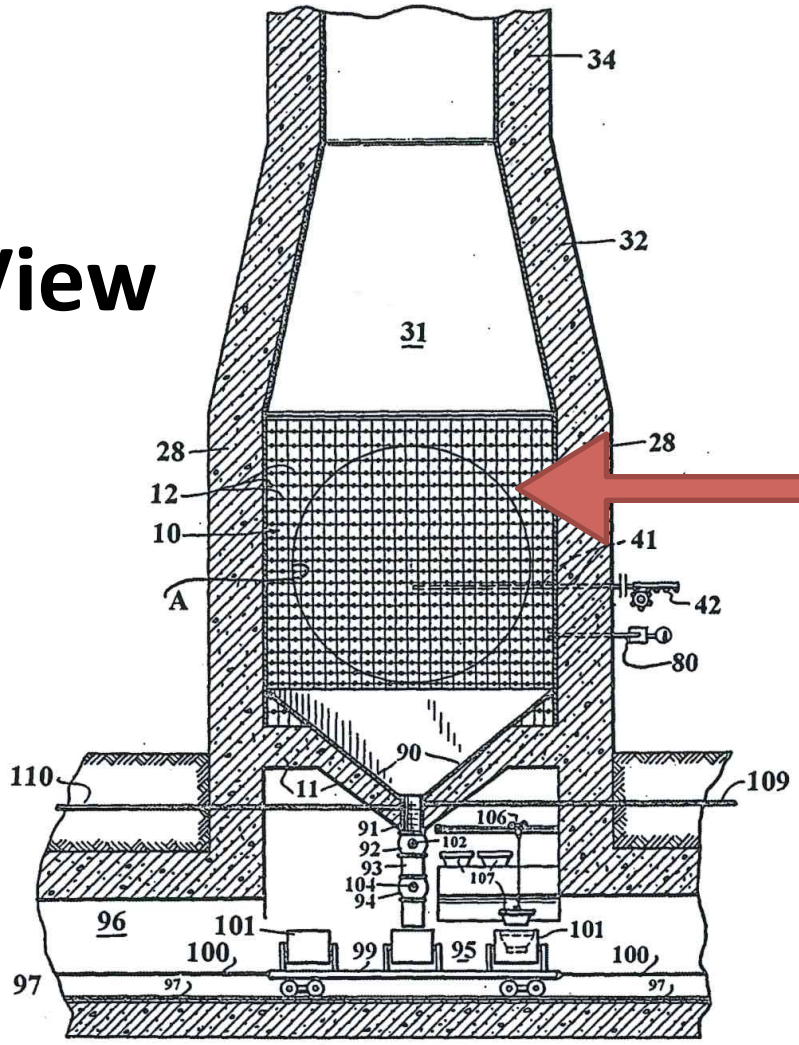
Air Cooled Neutronic Reactor

Air Cooled Neutronic Reactor
Application May 29, **1945**, Serial No. 596465
U.S. Patent No. 2836554 – Patented May 27, 1958
by **Enrico Fermi**
and **Leo Szilard**



Air Cooled Neutronic Reactor

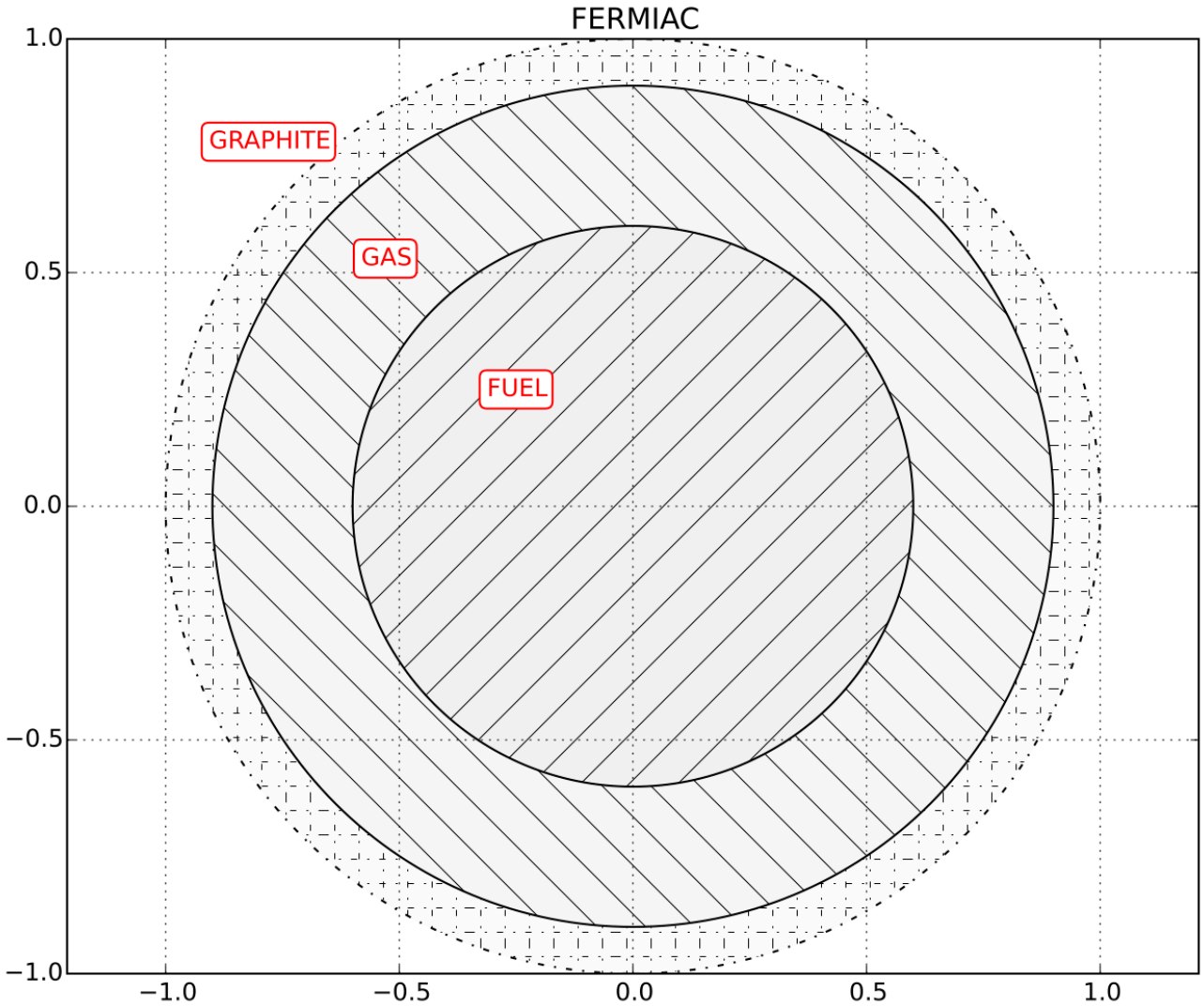
Front View

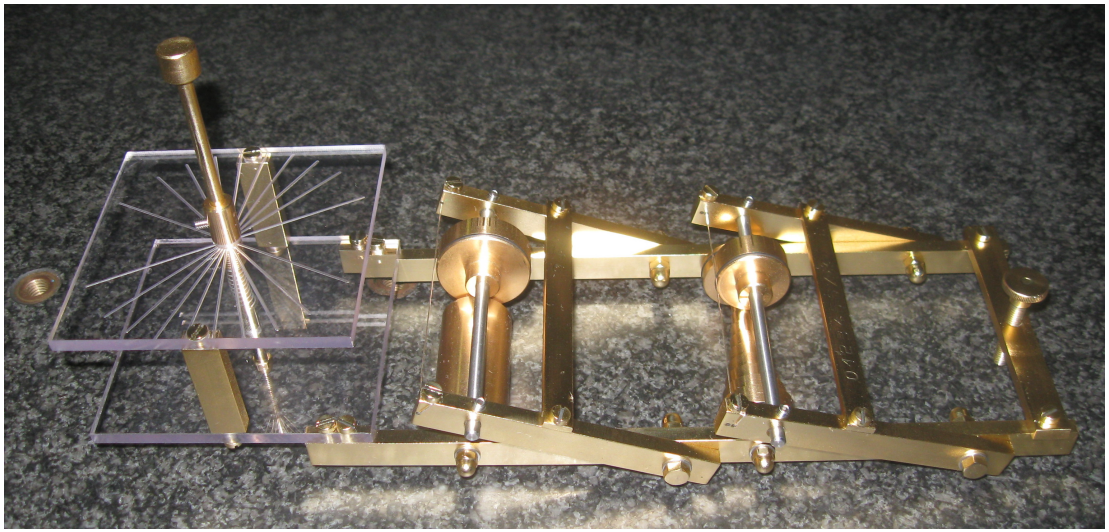


Reactor type:
Uranium-Graphite,
cooled by Air.

Graphite CUBE,
side: ~6m
With many
Symmetrical
Cells!!

Looking at a cell





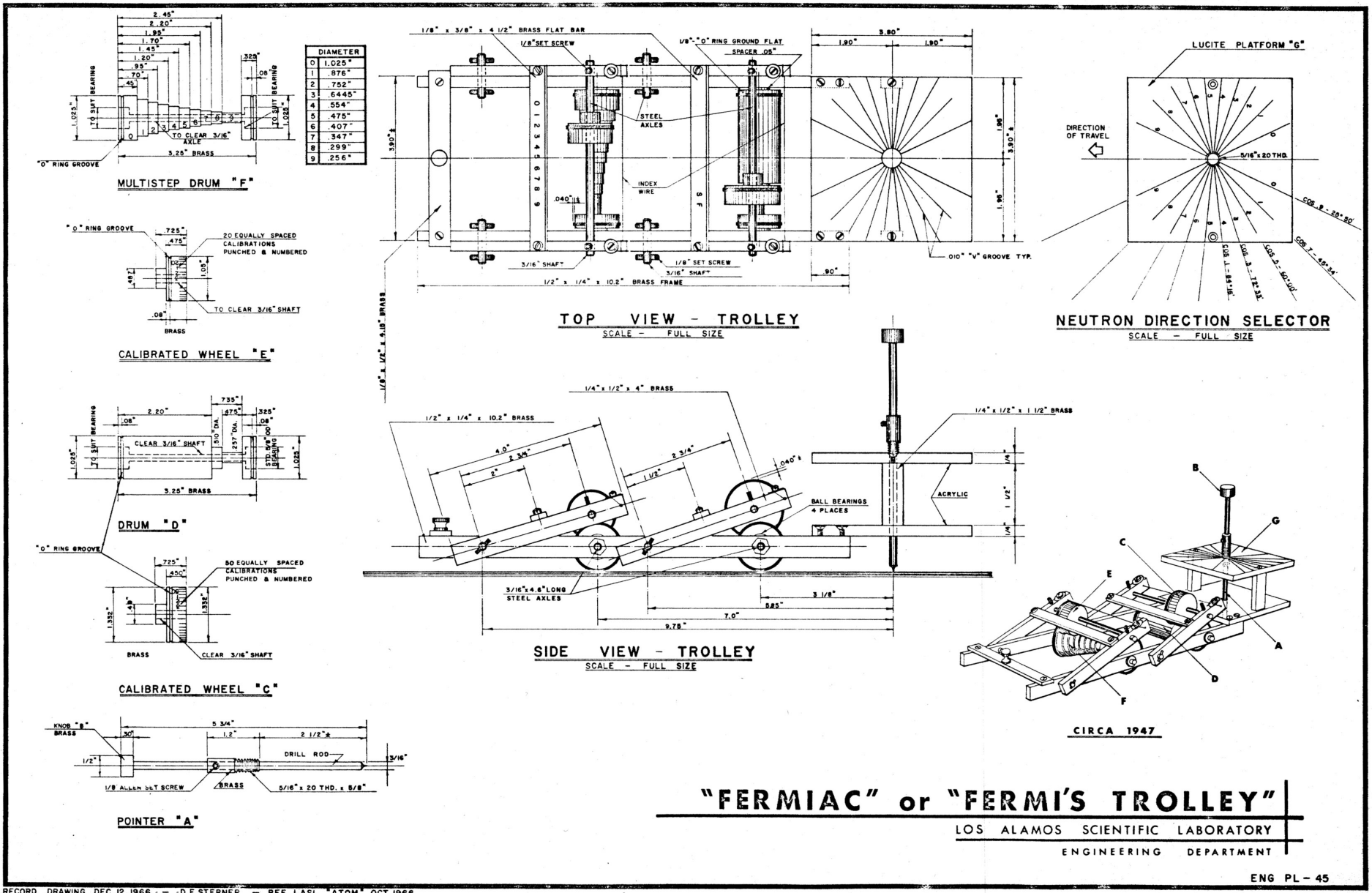
How the FERMIAC works

- The pencil is used to draw the neutron trajectory;
- The lucite platform serves as a neutron direction selector;
- Posterior Drum: measure the elapsed time based on the velocity (F ~2MeV or S ~ 0.0253 eV) of the particular neutron in question;
- Anterior Drum: measure the distance traveled by the neutron between collisions based on neutron velocity and the properties of the material being traversed.

Basic steps

1. Determine the site of the first collision each of the source neutrons (100 were initially used)
2. Establish the nature of the collision of each neutron (Elastic, Inelastic scattering, Fission (if the material allows))
3. Follow the fate of each neutron.

Fermiac Drawing

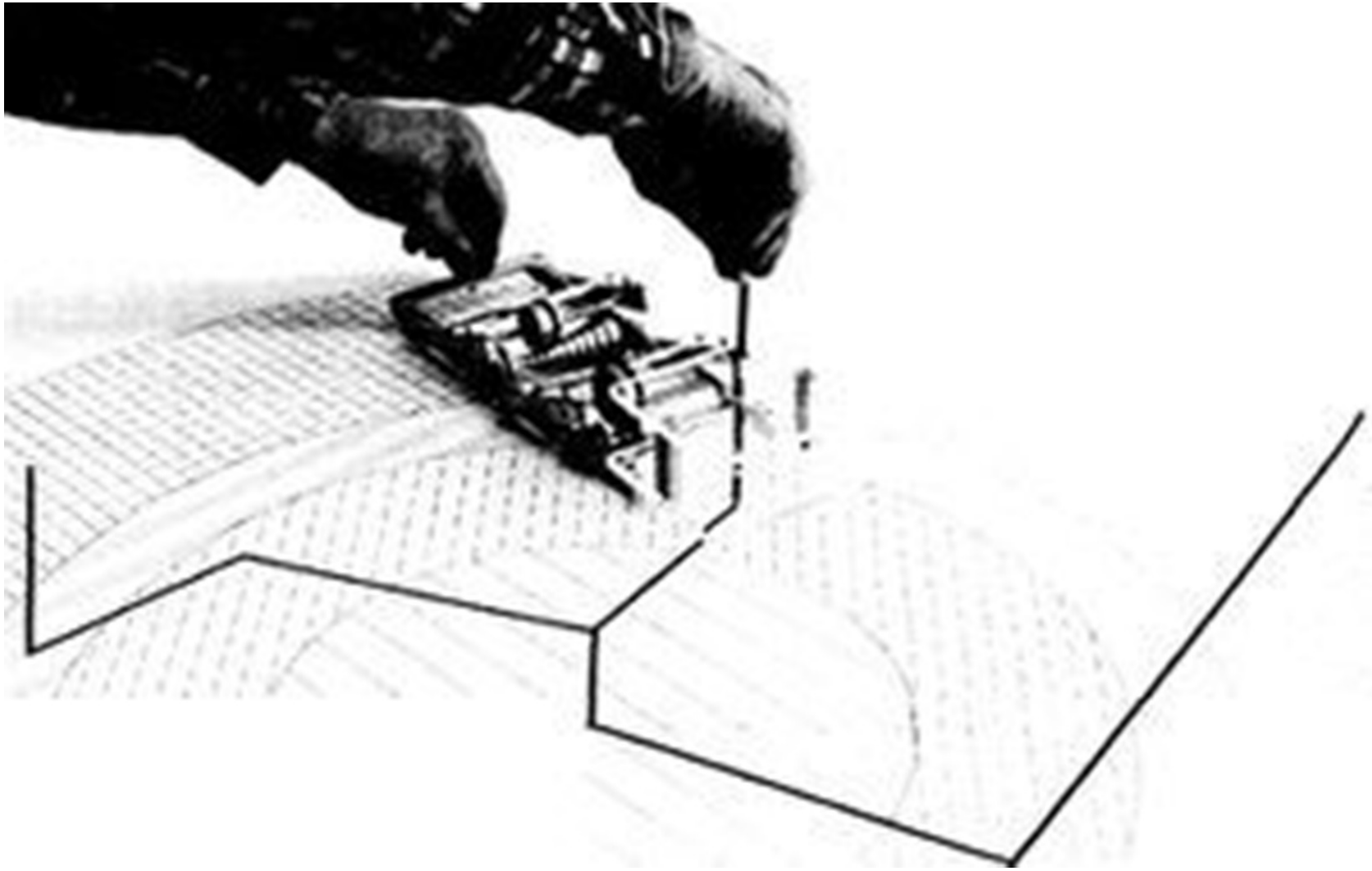


DIAMETER	
0	1.025"
1	.876"
2	.752"
3	.6445"
4	.554"
5	.475"
6	.407"
7	.347"
8	.299"
9	.256"

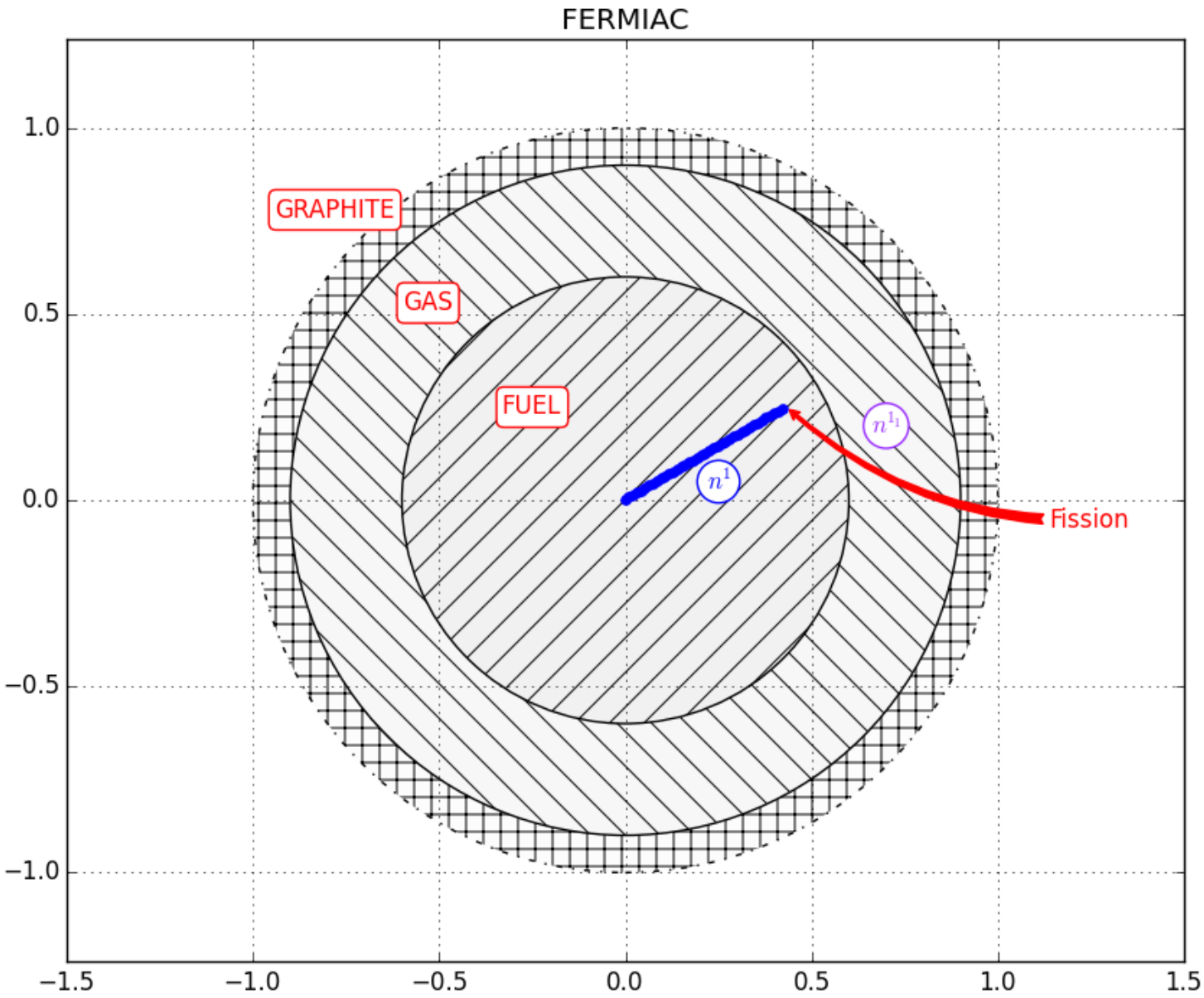
Detailed steps

1. Tip of the pointer A is placed in the location of one of the source neutrons.
2. Calibrated wheel C (50 eq. spaced calib.) is set to 0. Wheel C measures elapsed time (function of velocity: F or S). Wheel C is set on drum D (2 speeds).
3. Calibrated wheel E (20 eq. spaced calib.) measure the distance traveled by the neutron (function of velocity and material). Drum F (10 steps) represents the type of neutron (F or S) and the type of material under the pointer.
4. Draw random digit. The Fermiac is rotated about pointer A.
5. Draw random number. Distance to the next collision is set. Distance is read on Wheel E. If the pointer cross to a different material, shift of the wheel E on drum F.
6. When the pointer arrives at the collision distance: random number. Determine the nature of the collision:
   - Elastic: set wheel E to 0, and repeat previous steps
   - Inelastic: wheel C and wheel E may have to be repositioned to take care of change in velocity
   - Fission: neutron history terminated. Follow new neutrons

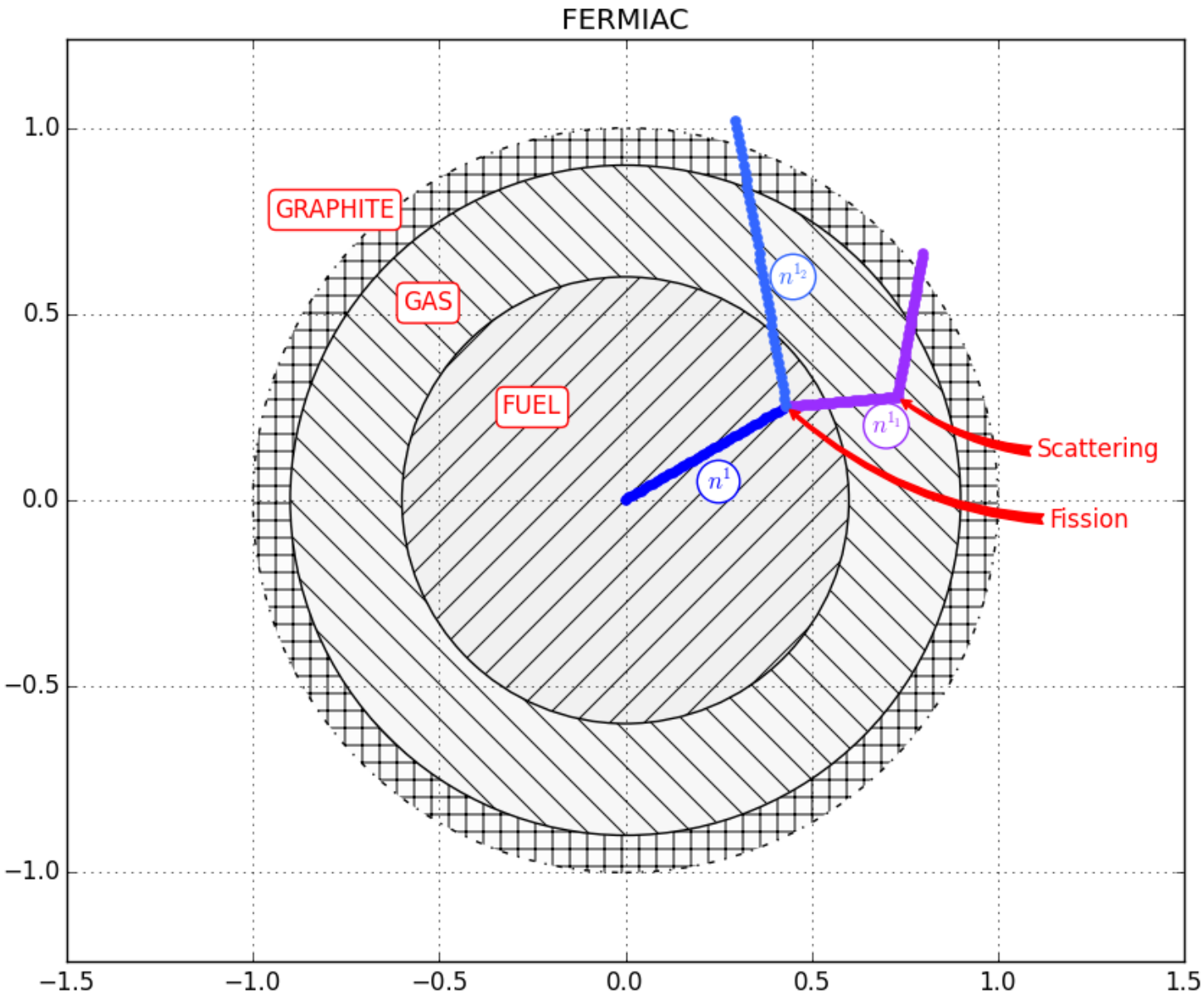
FERMIAC in operation (simulation)



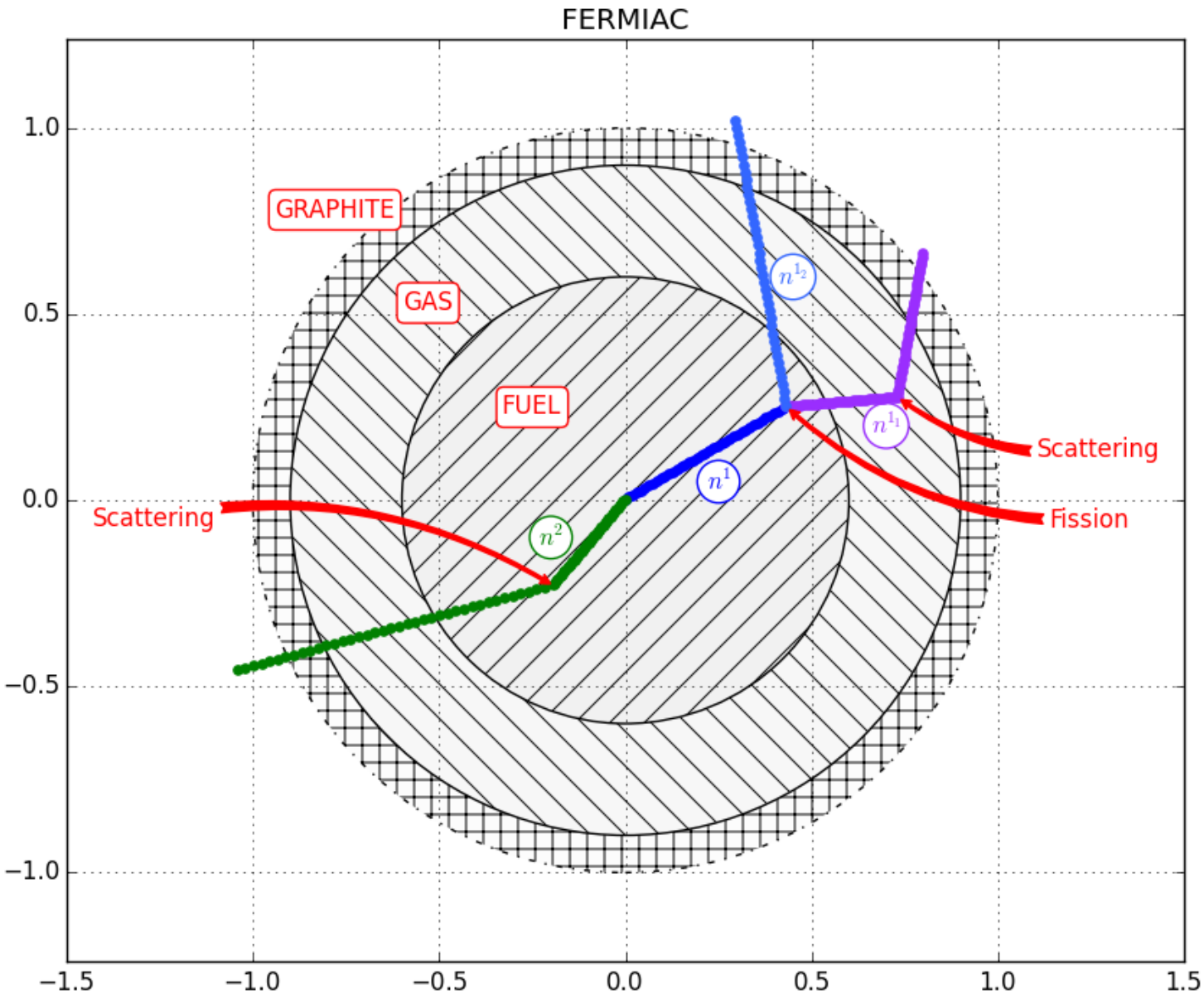
Simulation of the FERMIAC in operation (1)



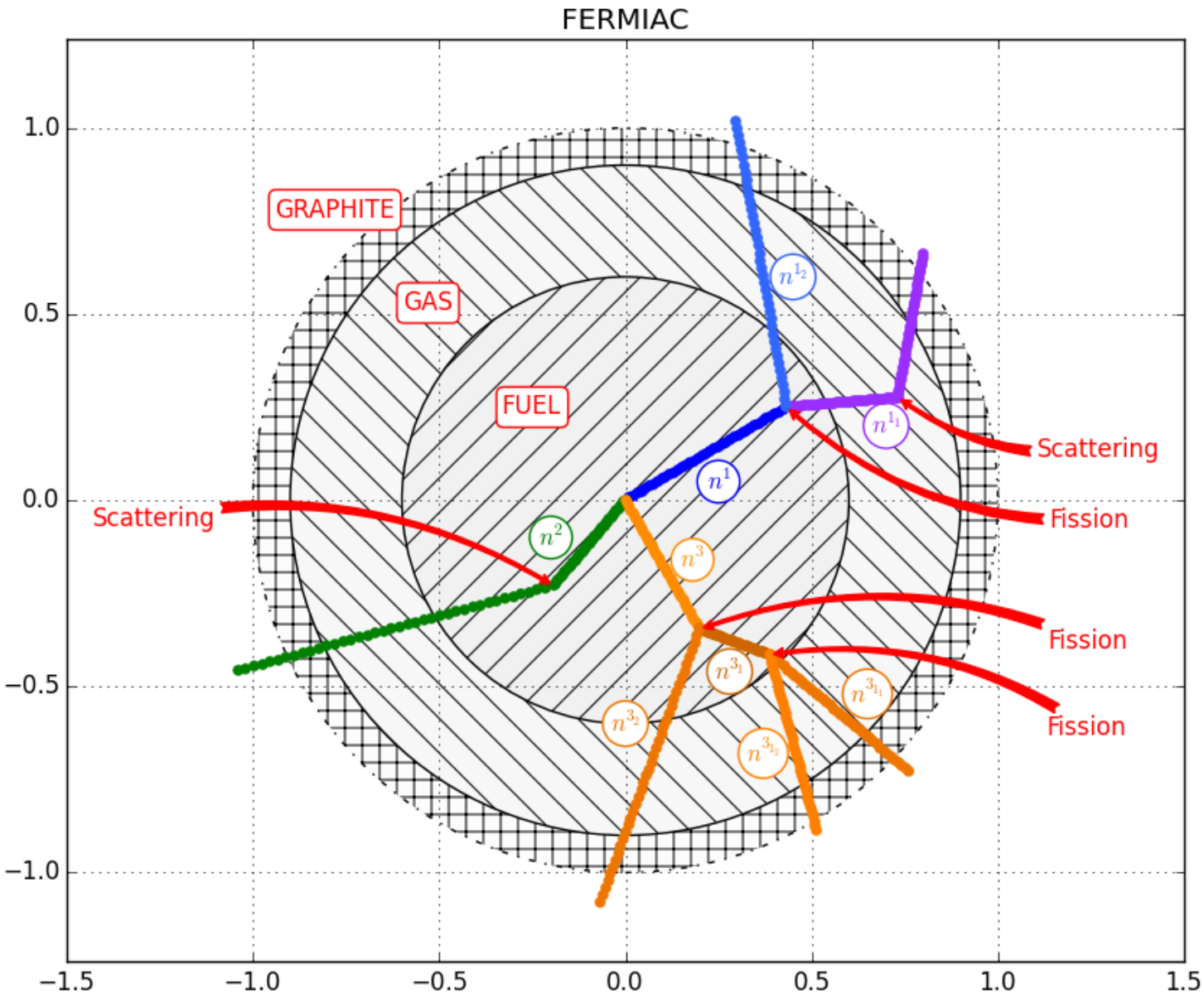
Simulation of the FERMIAC in operation (2)



Simulation of the FERMIAC in operation (3)



Simulation of the FERMIAC in operation (4)



Simulations of 100 neutrons